



Savannah land cover characterisation:

a quality assessment using Sentinel 1/2, Landsat, PALSAR and PlanetScope

Elias Symeonakis¹, Santiago Verón², Germán Baldi³, Santiago Bancho², Diego De Abelleira² and George Castellanos³

Manchester Metropolitan University, UK

²Instituto de Clima y Agua, INTA, Argentina

³Grupo de Estudios Ambientales - IMASL, UNSL & CONICET, Argentina

Abstract

The importance of savannahs worldwide has been widely acknowledged and documented. They are important ecosystems that are found on almost half of the African continent and a fifth of the Earth's surface. They consist of varying densities of grasses and woody vegetation and, due to their complexity, they have been centre stage for a number of land system science debates, such as, equilibrium dynamics, land degradation and desertification, or their contribution to the global carbon cycle, to name but a few. Their significance is directly linked to the numerous recent efforts to map and monitor their land cover as accurately as possible, most commonly by employing Earth observation technologies.

A recent case study by Symeonakis et al. (2018), carried out in a southern African savannah covering an area of ~44,000km², tested the performance of different combinations of Landsat- and PALSAR-based metrics from the dry and wet seasons. They concluded that the combination of multi-sensor and multi-season data provides the best results when mapping the main land cover types of woody vegetation, grasses, crops and urban/bare. Here, we take this work further by testing the performance of 15 similar models, this time based on a combination of Sentinel-1 and Sentinel-2 metrics from the dry and wet season, using the same study area, training and validation samples (extracted from 0.5 m RGB aerial photography). Our results corroborate the findings of the previous study: the combination of the Sentinel optical and C-band radar data from both seasons yielded the most accurate land cover Random Forests classifications: overall accuracy of 87%, overall k: 0.83. Very high user's and producer's accuracies were also found, especially for the woody class (User's: 93%; Producer's: 93%),

which is of primary concern in these savannah environments, due to its relevance to the land degradation processes that are dominant in the region: bush encroachment, overexploitation for fuelwood and deforestation. Similar to the Landsat/PALSAR study, the models based on SAR data only, were less accurate than the optical models. As anticipated, the L-band PALSAR data used in the previous study performed better in mapping the woody cover than their C-band counterparts, since L-band radiation is able to penetrate through the canopy layer and reach the woody stems and branches more efficiently. However, and interestingly, the Landsat-PALSAR study generally outperformed the Sentinel1/2 study, e.g. reporting the same omission but a 5% lower commission error for the woody class (estimated from the all-parameter model).

Additionally, we tested a novel land cover configuration mapping accuracy approach using PlanetScope 3m-pixel data, with the view to assessing the quality of the mapping of landscape configuration (e.g. number of crop paddocks) and not only its composition (e.g. crop vs other cover). For five test areas of 170 km² each, we performed object-based classifications of the PlanetScope imagery (two images per test area, one from the dry and one from the wet season). The results were less promising than those achieved for land cover composition: as an example, in one of our areas of focus, we determined 30 crop paddocks, 28 of which were of the circular centre pivot type ranging from 0.06 to 0.75 km². For the same area, we mapped a significantly larger number of paddocks with the Sentinel 2 data, most of which were of the rectangular-shaped type. This discrepancy was attributed to the spectral similarity between the crop and grass land cover types, as well as the averaging effect of the lower spatial resolution of the Sentinel.

Our findings, however, suggesting a multi-sensor and multi-seasonal approach, are an important addition to the emerging literature and can be used to guide efforts for achieving a highly accurate savannah land cover characterisation. Future work will investigate the use of the PlanetScope object-based classifications as training of the coarser-resolution models (e.g. Sentinel 1- and 2-based metrics), not only for improving the mapping of land cover configuration, but also for mapping fractional cover, e.g. % woody vegetation.